

CLAIMS

1. A network control framework apparatus for controlling resources at an intermediate network element connecting two or more communications networks comprising of the following entities:
 - i. the gateway module providing gateway functionality,
 - ii. the rule engine module to perform network resource control decision based on specified rules, wherein the rules are specified in a rule specification format hereafter known as a Rule Specification,
 - iii. a single or plural number of special package add on to the rule engine module where a said special package offers specialized functionality to the rule engine module, and
 - iv. the rule injection module to inject or remove Rule Specification to or from the rule engine module.
2. A means for distribution of Rule Specification as recited in claim 1 to a single or plural number of intermediate network elements as recited in claim 1, comprises of
 - i. the indications in the Rule Specification to indicates part or whole of the Rule Specification is to be distributed,
 - ii. the signature embedded into data packets to announce the capabilities of the intermediate network elements the data packet traversed,

- iii. the method of parsing the Rule Specification to determine if part or whole of the specified Rule Specification is distributed,
- iv. the method of identifying the target network element to distribute part or whole of a Rule Specification,
- v. the signaling embedded into data packets to inform target network element of the distribution of part or whole of Rule Specification,
- vi. the retrieval of the part or whole of Rule Specification distributed to the target network element from the intermediate network element that distributes the part or whole of Rule Specification.

3. A format of indications of part or whole of Rule

15 Specification for distribution as recited in claim 2 to a single or plural number of intermediate network element as recited in claim 1, comprises of

- i. the specification of the direction of distribution by specifying the endpoint of the specified direction,
- ii. the specification of the number of intermediate network elements towards the specified endpoint,
- iii. the specification of the number of intermediate network elements from the specified endpoint, and/or
- iv. the specific content distributed at the intermediate network elements.

4. A format of signature embedded into single or plural number of data packets as recited in claim 2 to announce the capabilities of the intermediate network elements as recited in
5 claim 1 the data packets traversed, comprises of
- i. the identification of the intermediate network element the signature belongs to,
 - ii. the special packages as recited in claim 1 that are installed on the intermediate network element the
10 signature belongs to, and
 - iii. the capability of accepting or generating part or whole of a Rule Specifications for distribution.
5. A means for intermediate network elements as recited in
15 claim 1 to store the signatures embedded in single or plural number of data packets as recited in claim 2 or 4 wherein the signatures of the intermediate network elements that the data packets traversed are stored with the starting and ending points between which the data packets traversed in the order of which
20 the data packets traversed and the transmission protocol the data packets belongs to.
6. The data format used to store the signature of intermediate network element as recited in claim 1, 2, 4 or 5,
25 containing the identification of the intermediate network

element and the installed special packages as recited in claim 1 at the intermediate network element.

7. The data format used to store the signatures of the 5 intermediate network elements as recited in claim 1, 2, 4, or 5 that a single or plural number of data packets flowing from one endpoint to another traverses, containing

i. the identification of the ending point that the data packets flow to,

10 ii. the identification of the starting point that the data packets flow from,

iii. the transmission protocol the data packets belongs to,

iv. the array of signatures of the intermediate network 15 elements in the order of the data packets traverse from the intermediate network element where the data format is stored to the ending point, and

v. the number of signatures of the intermediate network 20 elements in the order of the data packets traverse from the intermediate network element where the data format is stored to the ending point.

8. A method of extracting the signature of intermediate network elements embedded in single or plural number of data packets as recited in claim 1, 2, 4 or 5, to be stored in the data 25 format as recited in claim 7, comprises the steps of

- i. checking if there are embedded signatures in the data packets,
- ii. checking if there exist a data format as recited in claim 7 that is previously stored having the same starting and ending points and transmission protocol,
- 5 iii. allocating a new data format when there is no data format that is previously stored having the same starting and ending points and transmission protocol,
- iv. purging data stored in the data format that previously existed having the same starting point, ending point and transmission protocol,
- 10 v. preparing an empty last-in-first-out data structure,
- vi. extracting each embedded signature in the data packet and pushing it to the last-in-first-out data structure,
- 15 vii. removing each element in the last-in-first-out data structure and recording it to the data format as recited in claim 7, and
- viii. recording the number of embedded signature extracted in the data format recited in claim 7.

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9. A method of parsing the Rule Specification as recited in claim 2 to determine if part or whole of the Rule Specification is to be distributed comprises the steps of

- i. checking each rule in the Rule Specification for syntactical validity,

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- ii. rejecting the rule if there is syntactical errors,
- iii. checking the rule for the distribution indication as recited in claim 3,

iv. evaluating the rule locally if there exist no distribution indication,

v. determining the remote intermediate network element to distribute the rule to,

vi. evaluating the rule locally if no suitable remote intermediate network element to distribute the rule to can be found,

vii. checking if the remote intermediate network element contains the special package or special packages required in the rule,

viii. evaluating the rule locally if the remote intermediate network element do not have the required special package or special packages, and

ix. distributing the rule to the remote intermediate network element.

20 10. A method of determining the remote intermediate network element that a rule is to be distributed to as recited in claim 9, given the distribution indication as recited in claim 3, comprises the steps of

i. the method of locating the data format as recited in claim 25 7 with the matching starting point, ending point and

- transmission protocol,
- ii. declaring no suitable remote intermediate network element if no data format as recited in claim 7 can be located,
- iii. setting the a temporary variable to the specified number of the intermediaries towards or from the specified endpoint in the given distribution indication,
- iv. setting the temporary variable to the value of the number of intermediaries as given in the located data format as recited in claim 7 if the specified number of the intermediaries towards or from the specified endpoint in the given distribution indication is greater than the number of intermediaries towards or from the specified ending point in the given distribution indication,
- v. whereas the specified distribution indication as recited in claim 3 consists of the specification of the ending point and the specification of the number of intermediate network elements towards the specified ending point, set the temporary variable to a value equals the number of intermediaries given in the located data format as recited in claim 1 minus the original value in the temporary variable,
- vi. whereas the specified distribution indication as recited in claim 3 consists of the specification of the ending point and the specification of the number of intermediate network elements from the specified ending point, set

the temporary variable to a value equals the original value in the temporary variable minus 1,

- vii. declaring the remote intermediate network element to be the network element specified in a signature stored in the located data format as recited in claim 7 where the signature has an index in the array of signatures in the located data format as recited in claim 7 equals to the value stored in the temporary variable should such an index exists, and
- 10 viii. declaring no suitable remote intermediate network element should the index equal to the value stored in the temporary variable does not exist in the array of signatures in the located data format as recited in claim 7.

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11. A format of signalling to signal the intermediate network element as recited in claim 1 to express the desire to distribute collection of a single or plural number of rules in a Rule Specification to the intermediate network element consisting of

- 20 i. the identification of the intermediate network element where the collection of single or plural number of rules in a Rule Specification is distributed to,
- ii. the identification of the intermediate network element where the collection of single or plural number of rules in a Rule Specification is distributed from, and
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iii.the identification of the collection of single or plural number of rules in a Rule Specification.

12. A means of retrieving the collection of single or plural
5 number of rules in a Rule Specification from the intermediate network element as recited in claim 1 that distributes the collection of rules by the intermediate network element where the collection of rules is distributed to, comprises of
- i. the establishment of a communication channel between
10 the intermediate network element where the collection of rules is distributed to and the intermediate network element where the collection of rules is distributed from,
 - ii. the provision of the identification of the collection of rules
15 that is distributed as recited in claim 11 via the communications channel by the intermediate network element where the collection of rules is distributed to, and
 - iii.the transmission of the collection of rules that is distributed via the communications channel by the intermediate network element where the collection of rules is distributed from.

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25 13. A network control framework apparatus for controlling resources at an intermediate network element connecting two or more communications networks, wherein an endpoint node

hereafter known as a client node sends a request to the other endpoint node hereafter known as a server node, via a single or plural number of the intermediaries, and the server node accepts the request with an appropriate response, and a 5 communications channel is set up between the server content server and the client node through the intermediaries, and the server node starts transmitting data packets through the communications channel to the client node until the client node sends a request, via the intermediaries, to tear down the 10 communications channel, and the client node may transmit information about the transmission statistics back to the server node, comprises of the following entities:

- i. the gateway module providing gateway functionality,
- ii. the rule engine module to perform network resource 15 control decision based on specified rules, wherein the rules are specified in a rule specification format hereafter known as a Rule Specification,
- iii.a single or plural number of special package add on to the rule engine module where a said special package offers specialized functionality to the rule engine module, and
- iv.the rule injection module to inject or remove Rule Specification to or from the rule engine module.

14. A means of providing the author of Rule Specification as 25 recited in claim 13 to trigger a singular or plurality of rules at a

intermediate network element as recited in claim 13 based on
the following control methods

- i. the rule to be evaluated when the intermediate network
element received a request packet from the client node
5 to the server node,
- ii. the rule to be evaluated when the intermediate network
element received a response packet from the server
node to the client node,
- 10 iii. the rule to be evaluated when the intermediate network
element received a data packet containing contents
sent by the server node to the client node through the
communications channel established between the
server node and the client node,
- 15 iv. the rule to be evaluated when the intermediate network
element received a data packet containing the
transmission statistics from the client node to the
server node,
- 20 v. the rule to be evaluated when the intermediate network
element received a specified number of data packet
containing contents sent by the server node to the
client node through the communications channel
established between the server node and the client
node, and
- 25 vi. the rule to be evaluated when the intermediate network
element received a data packet containing contents

sent by the server node to the client node through the communications channel established between the server node and the client node after the elapse of a recurrent timer of a specified timer value.

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15. A set of parameters used in the Rule Specification as recited in claim 1 to control a single or plural number of content or content delivery sessions to achieve device independence in the delivery of said content, consisting of

- 10 i. the set of User Preference parameters consisting of the preferences of the human user consuming the content
 ii. the set of Agent Capabilities parameters consisting of the capabilities of the software agent employed by the human user to retrieve the content,
15 iii. the set of Device Capabilities parameters consisting of the capabilities of the hardware employed by the human user to retrieve the content, and
 iv. the set Natural Environment parameters consisting of the information about the environment in which the human user retrieves the content.
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16. The set of User Preference parameters as recited in claim 15 consisting of

- 25 i. the human user's preferences on the method of retrieving the content,

- ii. the human user's preferences on the language used in the retrieved contents,
- iii. the human user's preferences on the presentation of the retrieved content,
- 5 iv. the age group of the human user retrieving the content,
- v. the gender of the human user retrieving the content, and
- vi. the employment status of the human user retrieving the content.

10 17. The set of Agent Capabilities parameters as recited in claim 15 consisting of

- i. the type of software agent employed by the human user to retrieve the content,
- ii. the content formats supported by the software agent employed by the human user to retrieve the content,
- 15 iii. the content languages supported by the software agent employed by the human user to retrieve the content,
and
- iv. the transmission protocols supported by the software agent employed by the human user to retrieve the content.

20 18. The set of Device capabilities parameters as recited in claim 15 consisting of

- 25 i. the type of hardware employed by the human user to

retrieve the content,

ii. the processor speed and processor family of the hardware

employed by the human user to retrieve the content,

iii. the memory capacity of the physical and secondary

5 storage of the hardware employed by the human user to
retrieve the content,

iv. the display depth and resolution of the hardware employed

by the human user to retrieve the content, and

v. the operating system running on the hardware employed

10 by the human user to retrieve the content.

19. The set of Natural Environment parameters as recited in
claim 15 consisting of

i. the information of the location where the human user is

15 retrieving the content,

ii. the information of the mobility of the human user

retrieving the content, and

iii. the information of the illuminations conditions in which the
human user is retrieving the content.

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20. The special packages installed to the intermediate
network element as recited in claim 1 capable of interpreting
and evaluating Rule Specification that are constructed using
the sets of parameters as recited in claim 15, 16, 17, or 18.

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